PS/Int. MM 58-3
August 15th, 1958

METHOD FOR CALCULATING RESISTORS FOR P.F.W. CORRECTION AT INJECTION.

In order to facilitate eventual modifications in future, the process to be used is described in the following points.

1) Determine the $\Delta n/n$ vs. r curve to be obtained, by adding up effects to be corrected. (See report No. Ps/Int. MM 58-2, MM Int. 17).

2) Add up corrections from separate turns of p.f.w. (see table) with such weighting factors that the same $\Delta n/n$ vs. r curve is obtained.

The weighting factors then give the currents through each turn (or couple of turns in series). In the figures of the table the end and junction effects on the p.f.w. correction are included.

Most columns in the table give the effect of two turns connected in series, because it was found experimentally that it is not necessary to give every single turn a different current in order to obtain a satisfactory correction curve. With the turns grouped as in the table, it appears to be possible to approximate the existing error curve in the median plane with a precision better than that with which the errors are known.

The plus and minus signs in the table are given in such a way that corrections of this polarity are obtained by short-circuiting the indicated terminals over a resistor.

If the other polarity is required (negative weighting factor), the addition of a pick-up loop in series with the resistor is necessary. The polarity of the pick-up loop should be chosen so that the voltage induced in it opposes (and exceeds) the volta e induced in the turns considered. The induced voltages are given in the bottom line of the table.

To the obtained correction should now be added the last column ("pick-up loop") with the appropriate weighting factor, but with positive sign.

If the above described procedure for combining a set of turns with a pick-up loop has to be used for several adjoining combinations of turns (for instance, for the 3rd, 4th and 5th column of the table), it is possible to use one or more pick-up loops in series, in opposition to the turns considered, also connected in series. (In the example given above, terminals 19 and 10 would be connected to two series-connected pickup loops in series with a resistor.) In this way one can usually save in the number of pickup loops necessary, and reduce also their contribution to the injection field. If the currents required in the series-connected turns are not the same, one chooses the highest current for the series-combination, and reduces the current in those turns where it is necessary by short-circuiting these turns by resistors. These resistors do not act as shunts over the turns (the turns resistance being very low), but they cause opposite induced currents to flow through these turns in addition.

This procedure should only be adopted if the currents required in the different series-connected turns do not differ too much.

3) If the currents required are known, one can choose the resistors by dividing the total induced voltage in each circuit by the required current. If pick-up loops are in the circuit, one takes the voltage induced in the pick-up loops, minus the voltage induced in the turns in series with them.

The resistance of each pick-up loop is about 117 mΩ. This should be taken into account in determining the value of the resistors in series with pick-up loops. The resistance between terminals 6 and 1 is about 58 mΩ, one half of a pick-up loop being used in this circuit. The resistance of the other turns can be neglected.

Unused pick-up loops must be connected on one end to the rest of the windings in order to prevent discharges during the high voltage tests.

4) The calculation described above is only an approximation. In any case it should be checked by measurements. These measurements should include end and junction effects. Starting from the difference between measured and calculated Δn vs. r curves, a second order approximation can then be calculated.

5) The influence of the p.f.w. corrections on B_o can be computed from the table using the second line from the bottom. The influence on n, caused by this ΔB_o, is already included in the rest of the table. The existence of this ΔB_o means that injection will take place at a slightly different current in the main coils.

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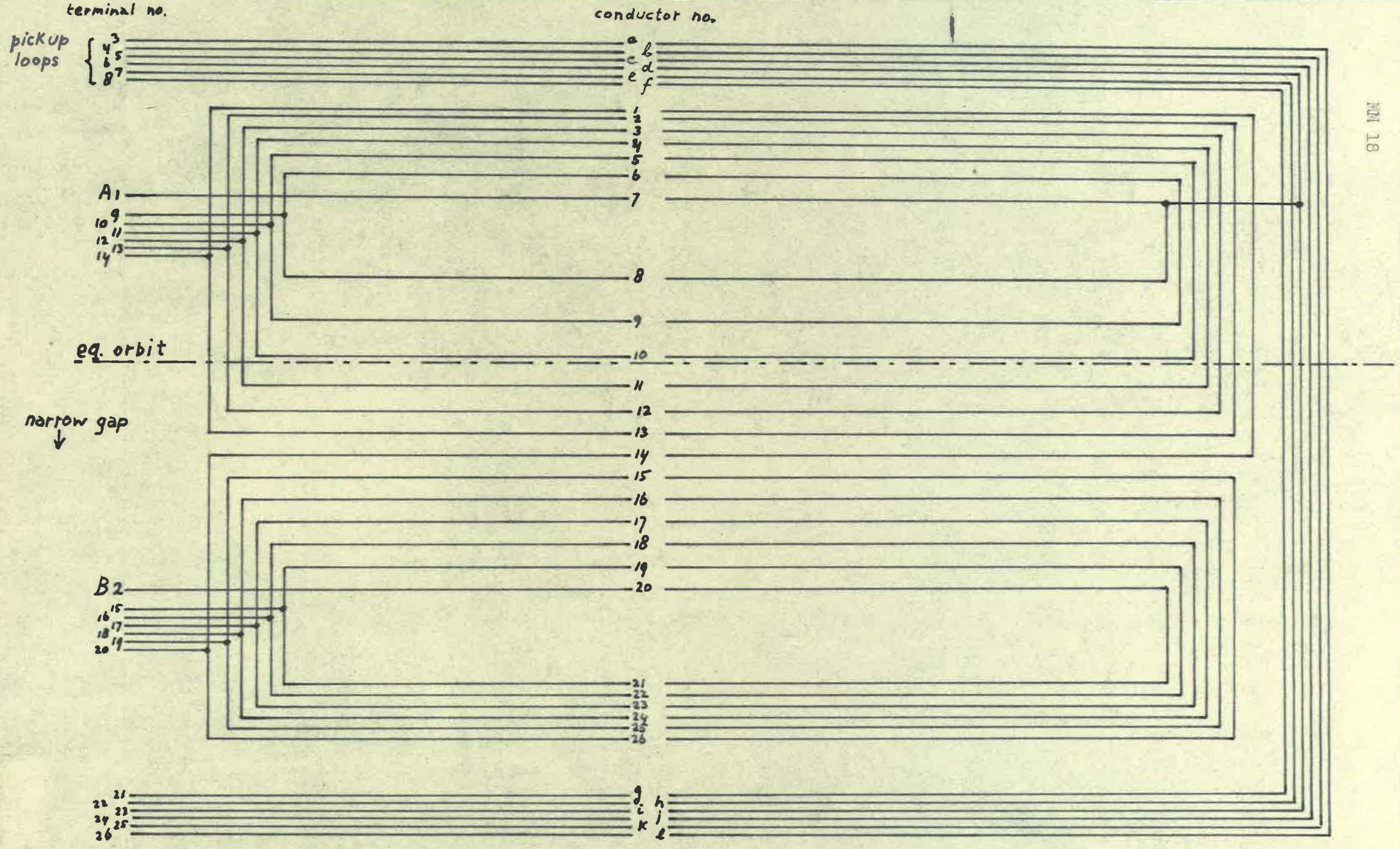

Top view of poleface winding sheet

Corrections $\Delta n/n$ at injection in 10^{-3} o/o per amp.

See drawing

The effect of ΔB_o on n is included in these figures.

Terminals No.	2, 17	17, 19	19, 14	14, 12	12, 10	10, 1	1, 6	Pick-up loop 23, 6
Conductors No. / r (cm)	20, 19, 18 21, 22, 23	17, 16, 24, 25	15, 14, 26, 1	13, 12, 2, 3	11, 10, 4, 5	9, 8, 6, 7	7 d	i d
- 7	- 45	- 39	+ 58	-139	- 301	- 263	+ 163	- 35
- 6	- 26	- 43	+ 30	- 94	- 200	- 26	+ 151	- 21
- 5	- 15	- 34	- 4	- 42	- 63	+ 268	+ 125	- 9
- 4	- 9	- 23	- 28	+ 25	+ 125	+ 554	+ 94	+ 2
- 3	- 6	- 16	- 39	+ 120	+ 389	+ 764	+ 65	+ 10
- 2	- 6	- 16	- 66	+ 249	+ 725	+ 833	+ 43	+ 16
- 1	- 7	- 23	- 110	+ 452	+ 1095	+ 761	+ 27	+ 20
0	- 10	- 41	- 200	+ 774	+ 1376	+ 598	+ 16	+ 23
1	- 16	- 81	- 376	+ 1224	+ 1433	+ 425	+ 9	+ 25
2	- 34	- 163	- 693	+ 1661	+ 1249	+ 288	+ 5	+ 26
3	- 71	- 332	-1159	+ 1902	+ 942	+ 195	+ 3	+ 28
4	- 154	- 658	-1808	+ 1776	+ 656	+ 135	+ 1	+ 29
5	- 332	-1215	-2231	+ 1389	+ 454	+ 98	+ 1	+ 29
6	- 702	-1933	-2160	+ 980	+ 332	+ 74	+ 1	+ 30
7	-1401	-2444	-1672	+ 688	+ 265	+ 59	+ 1	+ 31
Effective ΔB_o (in gauss/amp)	+ 0.04	+ 0.04	+ 0.31	+ 0.50	- 0.29	- 0.07	+ 0.025	- 0.28
Voltage induced for dB_o/dt = 15 Kg/sec (in volts)	0.777	0.836	0.010	0.812	0.571	0.305	0.090	1.081